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by

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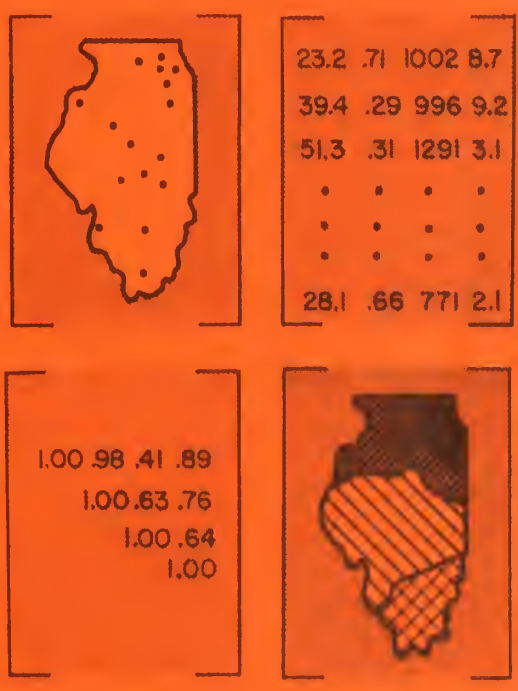

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REGIONAL CHANGES IN PETROLEUM SUPPLY, DEMAND AND FLOW IN THE UNITED STATES: 1966-1980

Ronald J. Swager

ABSTRACT

During the 1970's, changes due to increasing petroleum demand and the exploitation of Alaskan oil will have important effects on United States petroleum regions. Comparisons between present and future supply/demand conditions and patterns of interregional flow are made to determine general changes which will occur as well as those changes specifically due to the use of Alaskan oil. The major changes by 1980 will occur in predicted deficit regions along the Atlantic Seaboard and the Midwest. Most other changes will be experienced in the foreign petroleum countries, imports from which will increase significantly. The general effect of increased demand will be to increase the need for supplies from any feasible source. In order to minimize foreign imports and high cost exploration and recovery, availability of Alaska's oil will be a necessity.

INTRODUCTION

The petroleum industry is one of the largest and most important segments of the United States industrial sector. Because of this importance, considerable research has been conducted concerning past, present, and future economic conditions in the industry (U.S. Dept. of Interior, 1965; Williamson, 1959-63; Southwestern Legal Foundation, 1965). Much of this research about present and future conditions investigates changes in the industry relative to the nation as a whole. However, information about modifications at the regional level seems to be relatively scarce despite its relevance to regional economies and to individual petroleum firms. Because economic change in the petroleum industry affects the national economy, significant but variable effects at the regional level can also be postulated. Therefore, additional information about the nature of and the dimensions of regional variation in the oil industry and related economic effects is needed.

During the 1970's, two significant changes in the national petroleum industry are likely, both of which will have important impacts on regional economies and individual petroleum firms. One of these is the

readjustment which would occur if oil from Alaska's North Slope were supplied to the domestic market in large quantities. Among others, Haynes (1972) and Price (1972) recently discussed the main physical, ecological, and political aspects of this controversial topic. Numerous other sources (e.g., U.S. Dept. of Interior, 1971-72) treat the main economic aspects of the issue. The other variable during the decade relates to inevitable alterations in market conditions. Large predicted increases in the demand for oil means that domestic and/or foreign supplies will have to increase significantly.

If it can be determined, for example, which economic conditions of the petroleum industry are likely to change as a result of use of Alaskan oil, then planning agencies, petroleum firms, and associated businesses could be alerted to the altered economic conditions. Such information would facilitate smooth transitions within the national, and more particularly the regional economic systems.

PURPOSE AND PROCEDURE

Variation in supply and demand for petroleum combined with changes resulting specifically from increased utilization of Alaskan oil will alter the present pattern of interregional flows. Thus, the twofold purpose of this study is to predict these supply, demand, and flow changes and to identify some of their potential effects.

The study employs a three-step procedure to analyze supply/demand changes. The same method is re-employed to analyze changes in interregional petroleum flows. The analytical procedure is as follows: First, a comparison is made between two predicted future situations, the first assuming that Alaskan oil is not produced, and the second assuming that it is produced. This comparison will reveal expected future changes due solely to the utilization of North Slope oil. Second, predictions about future conditions are compared with the present in order to determine general changes which will result whether Alaskan oil is produced or not. Finally, a discussion of the possible regional effects of some of the changes indicated in steps one and two is made.

It should be pointed out that this study purposely avoids a consideration of changes which may occur in petroleum prices during the

study period. Price conditions are the most difficult to predict. The possible effects of future price changes are even more difficult to predict since little is known about a multitude of other related factors. Two generalizations can be made about price, however. First, if Alaskan oil is not produced, the pressures of demand on a limited supply will probably force prices up. Second, if Alaskan oil is produced, the pressures of demand may be eased sufficiently to allow for price stability. The assumption in this study, therefore, is that supply/demand conditions will determine price, subject to numerous exogenous factors. It is also assumed that those price changes which do occur will not be so large as to seriously affect the overall demand for petroleum.

REGIONAL DEMAND AND SUPPLY OF PETROLEUM

Present Market Conditions

Figure 1 illustrates the regional divisions used in this study. During World War II the United States was divided into Petroleum Administration for Defense (P.A.D.) districts which remain relatively intact (U.S. Dept. of Interior, 1965, p. 3). Most data on the petroleum industry are reported for these districts. In addition, other data are reported for petroleum "refinery districts" (American Petroleum Institute, 1967, p. 75) which are generally contained within P.A.D. districts. With a few minor exceptions, the regional boundaries shown in Figure 1 are derived from these P.A.D. and refinery districts.*

Future regional demand and supply of petroleum can be more easily projected once the present status of these market conditions is ascertained. Table 1 summarizes the net regional surpluses and deficits as well as demand and supply of petroleum. Data on supply were based on total production of crude oil in each region, while demand was calculated from total regional sales of crude and refined products. The data in

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*P.A.D. districts were not used because their level of aggregation is too large. Refinery districts were not directly used because some of them crossed state boundaries. Therefore, the regions shown in Figure 1 are those of the author.

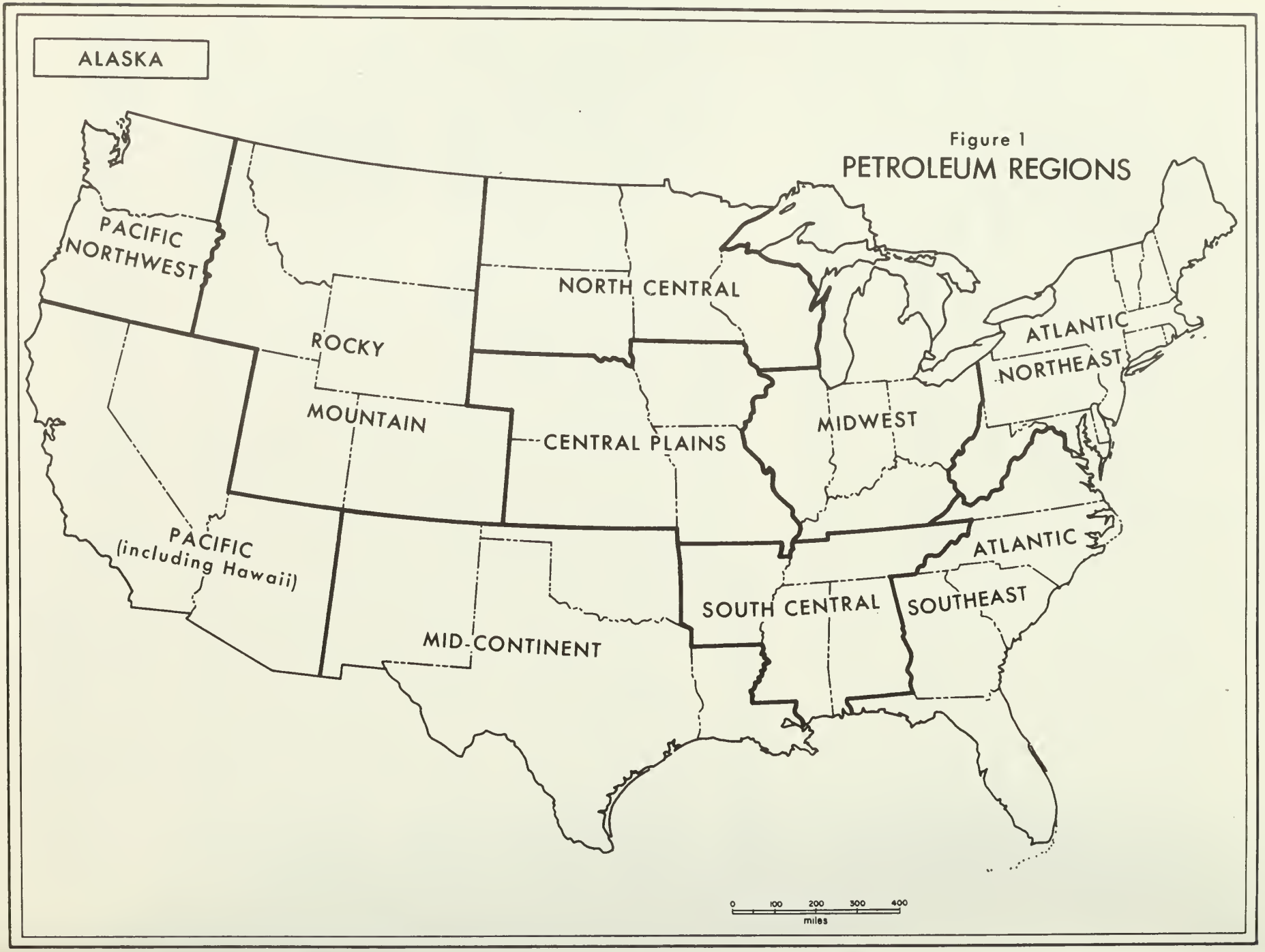


Figure 1
PETROLEUM REGIONS

TABLE 1 -- REGIONAL PETROLEUM PRODUCTION AND CONSUMPTION, 1966
(000 bbl.)

REGION	PRODUCTION	CONSUMPTION	SURPLUS	DEFICIT
DOMESTIC PETROLEUM				
Atlantic Northeast	10,136	1,351,425		1,341,289
Midwest	120,137	693,973		573,836
Atlantic Southeast	1,872	567,588		565,716
South Central	90,572	166,874		76,302
Mid-Continent	2,081,017	343,491	1,737,526	
Central Plains	122,392	216,326		93,934
North Central	27,475	189,847		162,372
Rocky Mountain	230,452	98,041	132,411	
Pacific Northwest	0	108,498		108,498
Pacific Southwest	359,563	376,227		16,664
Alaska	14,832	7,542	7,390	
IMPORTS OF FOREIGN PETROLEUM				
Canada	127,682	-	127,682	
Middle East	87,551	-	87,551	
Venezuela	846,051	-	846,051	
TOTAL	4,119,832	4,119,832	2,938,611	2,938,611

Source: American Petroleum Institute, Petroleum Facts and Figures (A.P.I., 1967).

Table 1 are for 1966, the most recent year for which information for all phases of the study was available.

Demand Assumptions

1. While several alternative means of delivering Alaskan oil to the main United States markets have been suggested, pipeline transportation still seems to be the most likely (Chemical Week, 1970). Assuming that a construction period of approximately four or five years will be required, it appears that a pipeline from the North Slope of Alaska could not be put into operation before the end of 1977. Allowing another two or three year period for numerous adjustments to be made within the industry, the year 1980 seems to be the best future target date to consider. By 1980 the major effects of the marketing of Alaskan oil should be experienced.

2. Based on estimates of the Department of Interior, the total United States demand for petroleum in 1980 is expected to be about 6.7 billion barrels, or 162 percent of the 1966 demand (Gillette, 1971, p. 1132). This figure seems to be appropriate because it is based on the 2.7 percent annual rate of growth in demand experienced in recent years.

3. In order to derive estimates of regional demand, petroleum consumption in 1980 is assumed to have an absolute but proportional increase for all regions. The figures in the column headed "Consumption" in Table 2 reflect this proportional increase.

Supply Assumptions

1. Estimates of regional supply (production) of petroleum in 1980 are not so easily derived. Different supply trends appear to exist for different regions. To simplify a complex relationship, total domestic and foreign supply (production) and total domestic demand (consumption) are assumed to be approximately equal in 1980.

2. As a comparison of Tables 1 and 2 indicates, all regions of the contiguous United States except the Rocky Mountain region will maintain their current (1966) levels of output. If Alaskan oil is to be supplied in significant quantities by 1980, production in many of the marginally productive fields may tend to be curtailed with the net effect

TABLE 2 -- PREDICTED REGIONAL PETROLEUM PRODUCTION AND CONSUMPTION, 1980
(000 bbl.)

REGION	PRODUCTION	CONSUMPTION	SURPLUS	DEFICIT
DOMESTIC PETROLEUM				
Atlantic Northeast	10,136	2,149,704		2,139,568
Midwest	120,137	1,095,219		975,082
Atlantic Southeast	1,872	910,602		908,730
South Central	90,572	267,399		176,827
Mid-Continent	2,081,017	561,880	1,519,137	
Central Plains	122,392	356,239		233,847
North Central	27,475	365,508		338,033
Rocky Mountain	576,130	157,680	418,450	
Pacific Northwest	0	174,762		174,762
Pacific Southwest	359,563	603,740		244,177
Alaska	730,000	13,140	716,860	
IMPORTS OF FOREIGN PETROLEUM				
Canada	200,385	-	200,385	
Middle East	733,246	-	733,246	
Venezuela	1,602,948	-	1,602,948	
TOTAL	6,655,873	6,665,873	5,191,026	5,191,026

Source: Author.

being to cancel out any (presumably modest) production increases which may occur in these regions during the 1970's. Hence, while exact equality cannot be expected, the assumption that regional production for the two time periods will be similar is not unrealistic. The only possible exceptions to this trend might be in the Mid-Continent and Pacific Southwest regions where advances in secondary and tertiary recovery techniques and new drilling may result in net production increases.

3. In addition to Alaska, the Rocky Mountain region is predicted to increase its level of production significantly. While it is believed that relatively large reserves of petroleum exist in this region, progress in exploration and drilling has been slow. This is primarily due to the high cost of drilling and high frequency of small, marginally profitable individual pools (Bigg and Espach, 1960; Pearcy, 1969; Woodward, 1969). By 1980 this region will increase its expected output by 2.5 times its 1966 production level. This is an arbitrary and perhaps somewhat optimistic estimate. Gillette (1971, p. 1132) predicts that Alaska's oil production in 1980 will be about 730 million barrels.

4. Despite the relatively large increases in output predicted for Alaska and the Rocky Mountain region, 38 percent of the 1980 domestic demand for petroleum must be supplied from foreign sources. Of the 2.5 billion barrels of foreign oil needed, Canada can perhaps be expected to supply about 200 million barrels. This figure represents roughly the same proportion of the total United States demand which Canada supplied in 1966. Large proportional increases in imports from Venezuelan oil fields are not likely. While Venezuela's exports of oil to the United States market are assumed to increase in absolute terms to almost double its present level, its percentage share would increase only slightly, as reflected in the 1980 production estimate in Table 2.

5. Finally, if the above estimates hold true, approximately 11 percent (733 million barrels) of the country's demand for oil in 1980 must be supplied from the remaining world oil reserves. Most of this amount will have to come from the Middle East because there seem to be no other reasonable alternative sources which can be developed quickly enough to meet the large demand.

Changes In Demand And Supply Resulting From Alaskan Oil Production

These assumptions about regional demand and supply of oil make it possible to identify changes between 1966 and 1980 by comparing Tables 1 and 2. The increased supply from Alaska will probably have little effect on regional demands for petroleum. It is assumed that the demand projections shown in Table 2 will exist even if Alaskan oil is unavailable, in which case regional demands would be satisfied by increased supply from other sources. Thus, the main effects of utilization of Alaskan oil relate to conditions of supply. These effects can be identified by considering what the differences in supply would be if Alaska's oil is not available in 1980.

The unavailability of Alaskan oil would require increases over the production estimates for the remaining producing regions in Table 2. The amount of the increase would depend on the characteristics of that portion of the petroleum industry located in each region. In the old and marginally productive fields, efforts to increase secondary and tertiary recovery of oil would be accelerated. Petroleum firms in these regions would face higher costs and greater risks than will otherwise be the case. Regions most likely to face this dilemma are the Atlantic Northeast, Midwest, Atlantic Southeast, South Central, Central Plains, and North Central regions. Efforts to increase secondary and tertiary recovery of oil would probably be greatly expanded in the Mid-Continent and Pacific Southwest regions if Alaskan oil is not available. Exploration and drilling activities would expand, particularly in the offshore fields where petroleum extraction would be most profitable.

As mentioned previously, estimates about petroleum production in the Rocky Mountain region are somewhat arbitrary. In the event that Alaskan oil could not be supplied to the United States market by 1980, a rigorous exploration and drilling program could result in output levels higher than the figure predicted in Table 2. Under these circumstances, the petroleum industry of this region would probably experience a period of booming expansion.

To summarize, it appears that availability of Alaskan oil in large quantities will help reduce the need for costly production from marginal wells and will minimize the necessity for expensive, high risk exploration and drilling. Use of North Slope oil will also allow for

less dependency on foreign sources than is apt to occur without it.

General Changes In Demand And Supply

Some of the general changes in regional supply and demand for petroleum have already been indicated above. In addition, an important result of the overall increase in demand with a less than equal increase in supply means that regional surpluses will shrink and deficits will rise. Thus, at the same time that the major consuming regions are increasing their demand for oil, most of the major domestic producing regions will have less available for interregional flows. For example, the deficit of the Midwest region will increase significantly, and the Mid-Continent region's surplus is likely to decline.

INTERREGIONAL PETROLEUM FLOWS

Significant regional impacts of Alaskan oil production and/or general supply/demand changes probably would occur if these changes caused a major alteration in the current pattern of interregional flows. In many cases the impact of alterations in the magnitude or direction of flow would be more important than the modifications in supply and demand indicated in Table 2. Consequently, it is important to devise a means by which reliable predictions about future interregional petroleum flows can be made.

A Theoretical Least Cost Model

One possible procedure can be established by examining the approach to the distribution of petroleum taken by individual firms in the industry. One goal of management of such firms is to minimize costs. Attainment of this goal allows for the greatest difference between total cost and total revenue, thereby contributing to profit maximization. One of the more important costs facing the petroleum industry is distribution (American Petroleum Institute, 1963, p. 37). Numerous studies (which are generally unavailable to the public) have been undertaken to determine the least costly way to distribute a

company's crude petroleum and petroleum products. It is suspected that the overall results of these studies may indicate that most firms distribute their products in approximately the least costly manner. However, no known study has examined the combined effects of all individual petroleum firms' attempts to minimize distribution costs. While individual firms may be following a least cost approach, can the same be said of the entire industry? This question can be answered by comparing the actual pattern of petroleum flows with a theoretical least cost solution. If the expected and the observed patterns compare favorably, then the industry is postulated to follow a least cost approach. Further, if the industry continues to minimize distribution costs, then the same model can be used to predict future petroleum flows.

One such approach which can be used is a linear programming technique known as the transportation model. Its formulation has been explained at length and its application discussed elsewhere (Smith, 1971, Ch. 20; Scott, 1971; Isard, 1960, Ch. 10). The model can be applied in transportation situations which require the maximization or minimization of some quantity. This optimal quantity is subject to a set of constraints which are dictated by the problem. In this study, the quantity to be minimized is the total cost of transporting petroleum between all regions which have petroleum surpluses or deficits.

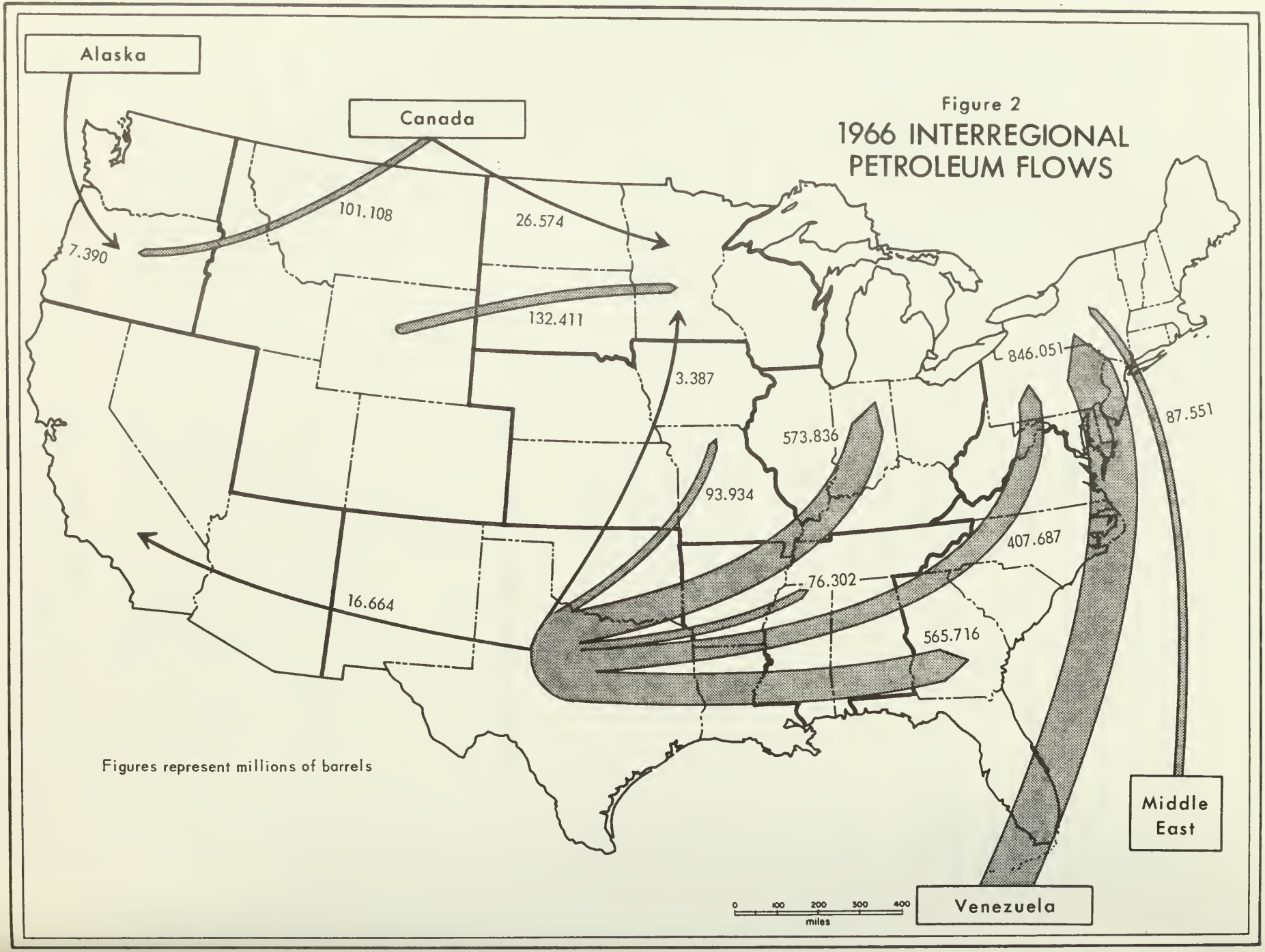
Present Pattern Of Interregional Flows

Supply and demand data are taken from the "Surplus" and "Deficit" columns of Table 1. In order to avoid the problem of defining costs of transport for different transfer agents, shipping costs of crude oil and petroleum products are assumed to be directly proportional to distance. This assumption is probably more applicable to the transport of petroleum than to other kinds of cargo. Distances are calculated as the shortest routes over which oil can be feasibly transported between the centers which have the greatest concentration of activity in petroleum in each pair of regions. Using these data and the transportation model, the least cost pattern of flow is calculated. The results are illustrated in Figure 2.

Swager (1971) states that this theoretical pattern generally corresponds to the pattern of flows which actually existed in 1966, at

Figure 2

1966 INTERREGIONAL PETROLEUM FLOWS



Figures represent millions of barrels

least for the regional scale used in this research. Therefore, the actual pattern of flows approximates a least cost pattern, and the petroleum industry as a whole does tend to follow a least cost distribution approach in much the same manner as the individual firm does. The fact that the actual and theoretical flows are similar also helps to resolve one of the more serious shortcomings of the transportation model, namely that "the linearity assumption underlying most spatial allocation analysis is rarely satisfied in practice" (Scott, 1971, p. 33). Consequently, the model is sufficiently reliable and accurate to be used for purposes of predicting future interregional flows of petroleum.

Future Pattern Of Interregional Flows

While the pipeline has already been chosen by the industry as the transport mode most likely to be used for shipping Alaskan oil, the debate about which pipeline route is best will probably continue long after the actual pipeline begins to operate. The two most frequently mentioned routes, the Trans-Alaskan and Trans-Canadian routes, have both good and bad attributes. In order to compare the two alternative routes, predictions of future flows were made for both. The regional surplus and deficit data (Table 2) are used for the calculations. Distance in miles is again used as a surrogate for cost of transport between each pair of regions. All measurements remain the same as those used in the calculations of 1966 flows except for the distances from Alaska to all other regions. The 1980 predictions were calculated twice using the distances associated with the two alternative pipeline routes. The two flow patterns which result are illustrated in Figures 3 and 4. Finally, regional surplus and deficit predictions were recomputed as if no North Slope oil is produced in 1980.* These data were then used to predict the flows for 1980 which are illustrated in Figure 5. To facilitate comparisons

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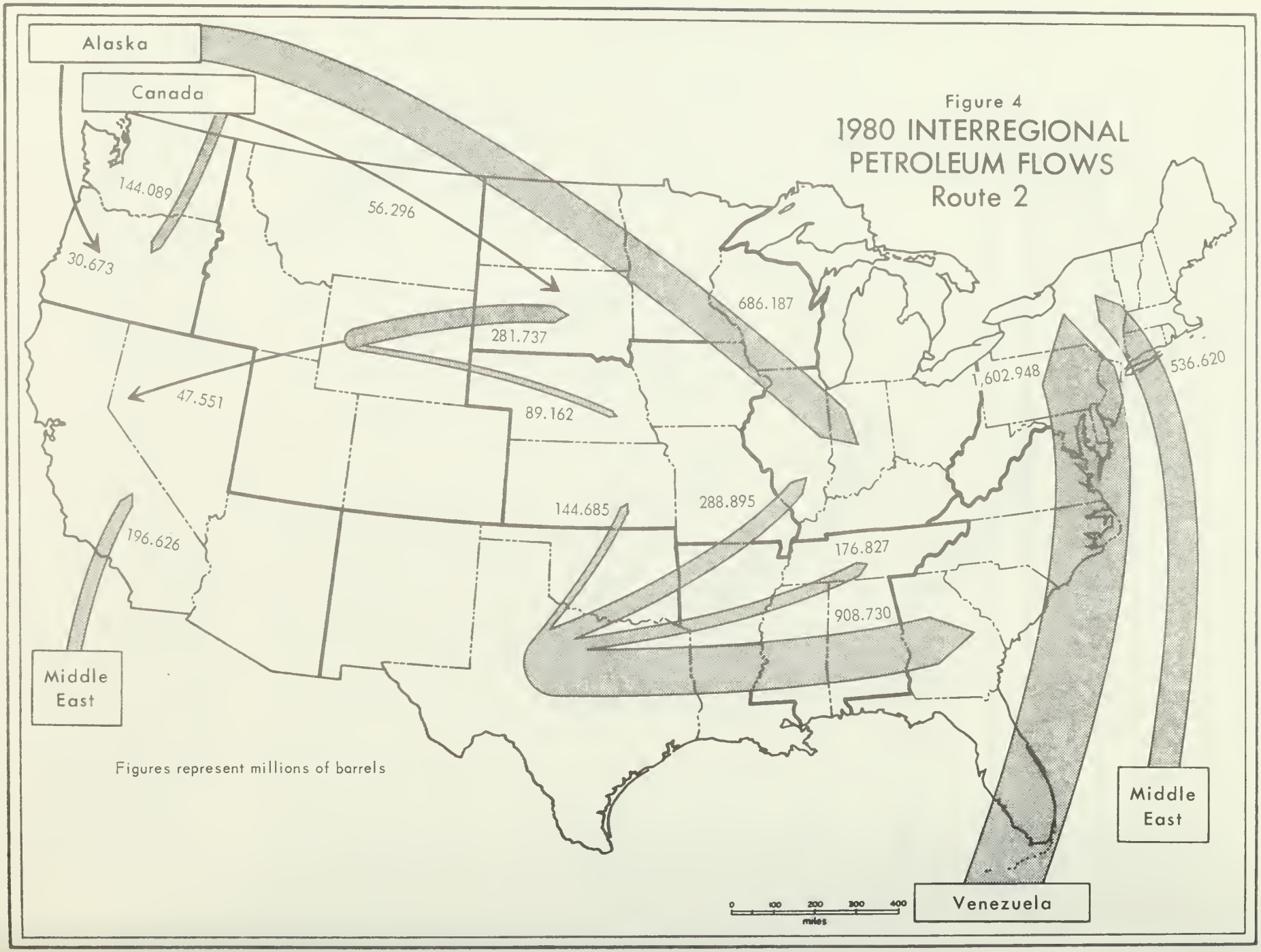
*In order to compensate for the hypothesized lack of supply from Alaska, the following changes were made in Table 2: Middle East surplus increased to 1,073,768,000 bbl.; Mid-Continent surplus increased to 1,738,120; Rocky Mountain surplus increased to 533,676; Pacific Southwest deficit decreased to 203,740. These figures are based on subjective assumptions about the ability of each surplus area to offset Alaska's unavailable supply.

Figure 4

1980 INTERREGIONAL PETROLEUM FLOWS Route 2



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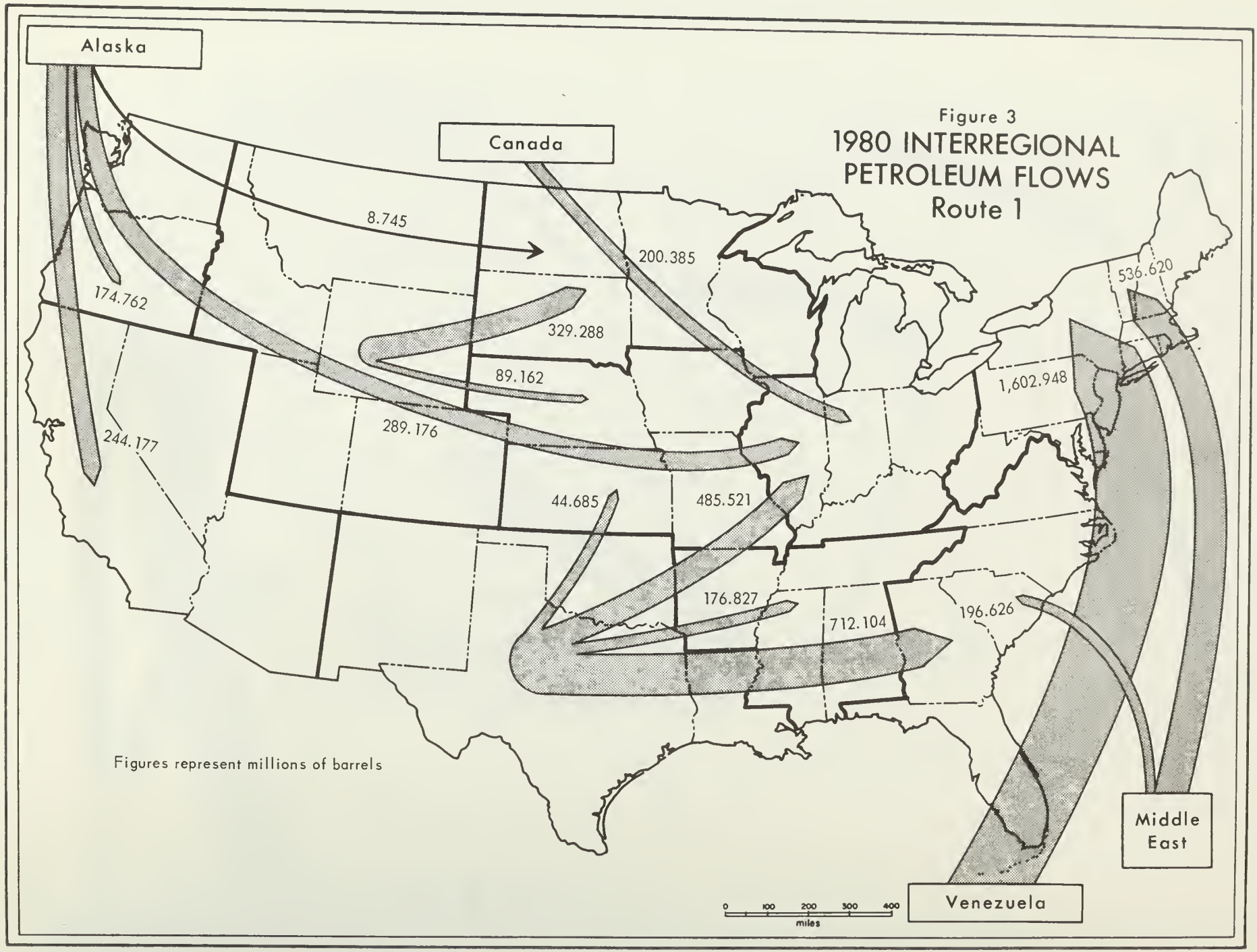
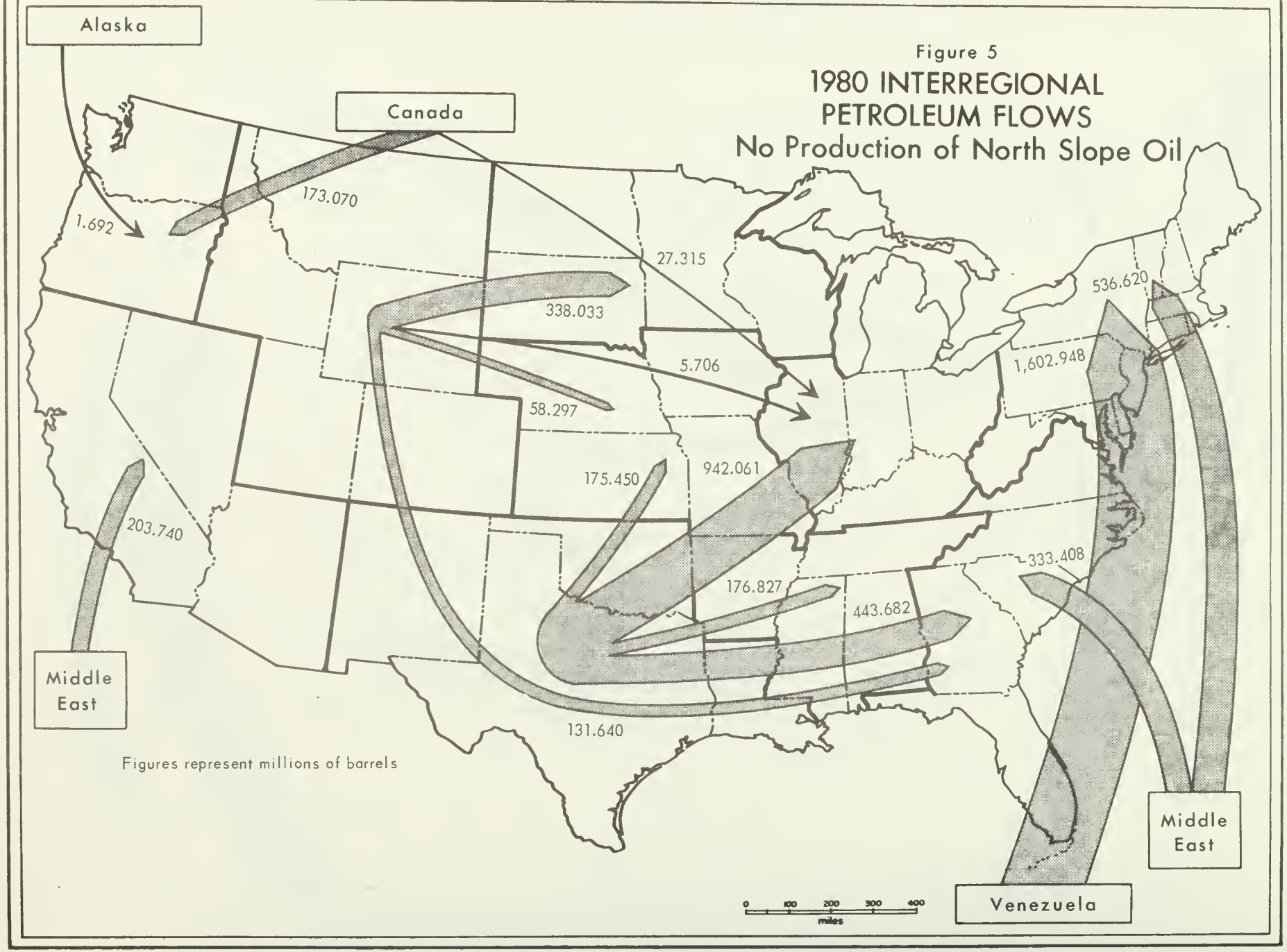


Figure 3
1980 INTERREGIONAL PETROLEUM FLOWS
Route 1

Figure 5

1980 INTERREGIONAL PETROLEUM FLOWS

No Production of North Slope Oil



Figures represent millions of barrels

of the three 1980 flow patterns, they are summarized with the 1966 flows in Table 3.

Changes In Flows Resulting From Alaskan Oil Production

The changes in flows resulting from use of Alaskan oil can be determined by comparing columns two and three in Table 3 with the fourth column. In the analysis changes in flows based on each alternative Alaskan oil route are discussed separately. Different flow predictions for the two potential pipelines occur because the respective distances from Alaska to all other regions in the transportation problem differ.

Route 1: (The Trans-Alaska Pipeline) The production of Alaskan petroleum will apparently have no effect on the flows of petroleum into the Atlantic Northeast and South Central regions since the predicted flows do not change, as shown in Figures 3 and 5. Of the remaining regions, the flows from the Mid-Continent region to the Central Plains and from the Rocky Mountain into the North Central, Midwest, and Central Plains regions are not significant enough to cause major changes in these regions. The remaining differences in flows seem to represent the most important changes.

In the Midwest region, use of the Trans-Alaskan Pipeline Route would result in acquisition of significant amounts of oil from three separate sources. Without Alaskan oil, the Mid-Continent region would remain the main supplier of oil to this region. However, without Alaskan oil the Atlantic Southeast will have to resort to significantly greater imports from the Middle East and from a domestic source as distant as the Rocky Mountain region. The main impact of this difference in flows to the Midwest and the Atlantic Southeast is felt in the Mid-Continent region. Comparison of Figures 3 and 5 indicates that availability of Alaskan oil decreases the competitive margin of firms in the Mid-Continent region for transporting oil to the Midwest. It does not change the cost for the Atlantic Southeast. While the transport of petroleum to Chicago from Alaska would be costly because of increased distance, the absence of Alaskan oil would be still less desirable. With no Alaskan oil, flows from the Rocky Mountain region and the Middle East into the Atlantic Southeast must increase significantly. Both of

TABLE 3 -- COMPARISON OF PETROLEUM FLOWS[1] FOR 1966 AND THREE ALTERNATIVE 1980 SOLUTIONS

REGION OF DESTINATION	1966 INTER-REGIONAL FLOW		1980 INTER-REGIONAL FLOWS ROUTE I[2]		1980 INTER-REGIONAL FLOWS ROUTE II[3]		1980 INTER-REGIONAL FLOWS NO NORTH SLOPE OIL PRODN.	
	Region of Origin	Quantity (000 bbl)	Region of Origin	Quantity (000 bbl)	Region of Origin	Quantity (000 bbl)	Region of Origin	Quantity (000 bbl)
ATLANTIC NORTHEAST	Venezuela Middle East Mid-Continent	846,051 87,551 407,687	Venezuela Middle East	1,602,948 536,620	Venezuela Middle East	1,602,948 536,620	Venezuela Middle East	1,602,948 536,620
MIDWEST	Mid-Continent	573,836	Mid-Continent Alaska Canada	485,521 289,176 200,385	Mid-Continent Alaska	288,895 686,187	Mid-Continent Canada Rocky Mtn.	942,061 27,315 5,706
ATLANTIC SOUTHEAST	Mid-Continent	565,716	Mid-Continent Middle East	712,104 196,626	Mid-Continent	908,730	Mid-Continent Middle East Rocky Mtn.	443,682 333,408 131,640
SOUTH CENTRAL	Mid-Continent	76,302	Mid-Continent	176,827	Mid-Continent	176,827	Mid-Continent	176,827
CENTRAL PLAINS	Mid-Continent	93,934	Mid-Continent Rocky Mtn.	144,685 89,162	Mid-Continent Rocky Mtn.	144,685 89,162	Mid-Continent Rocky Mtn.	175,550 58,297
NORTH CENTRAL	Rocky Mtn. Canada Mid-Continent	132,411 26,574 3,387	Rocky Mtn. Alaska	329,288 8,745	Rocky Mtn. Canada	281,737 56,296	Rocky Mtn.	338,033
PACIFIC NORTHWEST	Alaska Canada	7,390 101,108	Alaska	174,762	Alaska Canada	30,673 144,089	Alaska Canada	1,692 173,070
PACIFIC SOUTHWEST	Mid-Continent	16,664	Alaska	244,177	Middle East Rocky Mtn.	196,626 47,551	Middle East	203,745

1. All flows are predicted by the Linear Programming Transportation Problem.
2. Alaskan oil is delivered over Route I via Trans-Alaskan Pipeline to the port of Valdez and forwarded to the West Coast by tanker.
3. Alaskan oil is delivered over Route II via Trans-Canadian Pipeline to Chicago.

these flows also represent long distance movements. In the case of the Middle East, use of Alaskan petroleum elsewhere would make oil from other regions available to the Southeast, thereby reducing the need for large imports from this foreign source.

Of course, the major differences between Figures 3 and 5 relate to Alaskan flows. The most important of these, the flow into the Midwest, has already been discussed. The other two Alaskan flows represent receipts of oil which must otherwise originate in Canada and the Middle East. The Pacific Northwest and Southwest regions would fail to experience the increased refining activity likely to result from use of the Trans-Alaska Pipeline Route. Finally, significant investments in pipeline construction in the Pacific Northwest, Rocky Mountain, and North Central regions appear likely because of the need for a major new pipeline network in these areas. Such a network would distribute oil not only from Alaska, but also from the Rocky Mountain region to the requisite markets.

Route 2: (The Trans-Canadian Pipeline) Most of the changes resulting from the distribution of Alaskan oil across Route 2 are similar to those related to delivery over Route 1. In Figures 4 and 5 and in Table 3 there again is no difference in the flows into the Atlantic Northeast and South Central regions. Of the remaining flows, those from the Mid-Continent fields to the Central Plains; from the Rocky Mountain region to the North Central, Central Plains, Midwest, and Pacific Southwest regions; from Canada and Alaska to the Pacific Northwest; from Canada to the North Central region; and from the Middle East to the Pacific Southwest do not appear to be significantly different in Figures 4 and 5.

The changes which are the most significant are similar to those for Route 1. Availability of Alaskan oil shipped to the Midwest precludes the need for large shipments into that region from the Mid-Continent oil fields. Surpluses from the Mid-Continent region can be diverted more profitably into the Atlantic Southeast. This in turn eliminates the need for large movements of petroleum into the Southeast from the Rocky Mountain region and the Middle East.

To summarize, this analysis indicates that the United States regions most likely to be affected by changes in flow resulting from

Alaskan oil production are the major producing regions whose large surpluses will be transported to other regions. Other major effects are felt in foreign producing regions. The destination of Canadian oil is different for the two alternative pipeline routes, and availability of Alaskan oil allows for smaller imports from the Middle East without altering Venezuelan oil imports.

General Changes In Interregional Flows

The changes in market conditions predicted for 1980, particularly the conditions of supply, will cause changes in flow which are independent of the availability of North Slope oil. It is possible to identify these changes by comparing the future flow patterns with the present pattern, illustrated in Figure 2. The analysis below compares the 1966 flows only with the 1980 pattern shown in Figure 3, the most likely alternative.

While numerous differences in the flow patterns for the two years exist, the most important changes involve the flows originating in the Mid-Continent region. As previously mentioned, increases in demand within this region will cause a decrease in the amount of surplus oil available for interregional transport. This projection, and the fact that there will be increased deficits in regions more proximal to the Texas oil fields, will mean that the longest interregional flows from this region will no longer be profitable. Such a development would have an effect on the intracoastal shipping industry and on such major capital investments as the Colonial Pipeline which runs from the Mid-Continent region along the Gulf and Atlantic coasts to New York.

Another important alteration in flow out of the Mid-Continent region is the predicted reduction (rather than increase) in the amount of oil shipped to the Midwest. The recent investment in pipeline construction between these regions becomes somewhat questionable. Investments could perhaps be more profitably directed toward the construction of pipelines to transfer oil from Canada and Alaska into the Midwest.

Finally, the 1980 flow predictions indicate that the transport of oil by pipeline from the Mid-Continent to the North Central and Pacific Southwest regions would be suboptimal. Again, because of the availability of intervening demand opportunities, these long distance movements

(of relatively small quantities) will no longer be as profitable.

CONCLUSION

This study must be viewed in light of the various assumptions which underlie it. The key assumption is that the petroleum industry as a whole will continue to pursue a least cost approach to the distribution of its products. To the extent that this does not occur, flows will be misallocated and the national and regional economies involved.

The linear programming approach illustrated in this paper can be used with any alterations in the assumptions deemed necessary. However, based upon the assumptions used, this study suggests some potentially significant results. It shows that the large predicted increases in regional petroleum demand will create pressure upon any available domestic source of supply. These pressures will cause the need for significant alterations in the present pattern of interregional flow. Compounding these adjustments will be other changes which relate to the future availability of oil from Alaska's North Slope. Many of these changes will have important and varying effects at the regional level, effects for which preparations should be made.

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NOTES

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